

## **HERMAPHRODITIC (GENDERLESS) CONSTRUCTION SYSTEM**

### **CROSS REFERENCE TO RELATED APPLICATION**

This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/055,282, filed August 13, 1997.

### **BACKGROUND OF THE INVENTION**

This invention relates to construction toy systems. More particularly it relates to both hub and rod construction toy systems based on hermaphroditic and identical (genderless) connectors, and to building block systems also based on genderless connectors. In many cases the genderless connectors are integral to the parts being connected. These genderless connectors greatly extend the range of applications for this invention. In particular we disclose improvements to such construction systems that greatly facilitate connection perpendicular to the usual plane of connection for such systems. Said improvements can be characterized as female connectors that accommodate said genderless connectors – effectively converting them to male connectors.

This is a crowded art with much activity in the construction toy system part of it, with many U.S. patents, referred to by number below, known to the inventor which have some pertinence. U.S. Pat. No. 1,113,371 discloses the original rod and hub construction toy system with wooden hubs and rods and with the rod inserted into a hole in the hub and held there by friction and compression (interference fit). U.S. Pat. No. 1,707,691 discloses a hub and rod construction toy system with a hub of stamped metal and wooden rods with slit ends. The connection is formed by inserting the metal hub into the rod-end slit. A great many construction toy systems allow identical elements to be



having elongate square bars defining extensions. These extensions may be mutually inserted in orthogonal positional relationship. Patent 2,577,508 is a universal coupling with bifurcated tongues that mate. Patent 2,832,943 is a detachable coupling in which the male and female members are not identical but do have an orthogonal insert relationship. U.S. Pat. No. 3,224,222 is a universal joint with yoke members including cross-pintles for connecting the yoke members together.

Hermaphroditic connectors have been used in the electronic connector industry. The invention disclosed herein grew out of our prior electronic connector inventions. See Clever and Lyons U.S. Pat. No. 5,183,409 and continuation in part application 08/01/1994.

Other presently known U.S. Patents having interest are: 3,516,043; 3,070,769; 2,690,542; 3,011,143; 4,199,208; 3,634,811; 2,996,026; 3,070,769; 2,475,046; 2,470,282; 1,865,300; 2,577,508; 607,607; 3,552,145; 1,171,380; 2,740,271; 4,172,369; 2,460,231; 534,732, and 2,389,115. It is believed that the present invention is patentably distinct from the teachings of any of the above-cited patents.

## **SUMMARY OF THE INVENTION**

We disclose improvements to the construction toy systems disclosed in our copending related Application Serial No. 08/862,948 filed May 30, 1997 which describes toy systems all of whose parts directly interconnect by means of genderless connectors, The entire subject matter of said prior application being incorporated herein by reference. The improvements include: the use of the genderless connectors as either male or female connectors, a female connector that can be used with the genderless connectors, chamfered fingers to improve the ease of connection.

By the use of these genderless connectors plus the disclosed improvements a very wide range of very different and independent toy systems can be designed that freely inter-connect. In fact, the invention disclosed in the related application with the addition of the improvements disclosed in this application allows for the creation of a near universal construction toy system - one that allows for free inter-connection across a

wide range of construction toy types: hub-and-rod, beam-and-beam, blocks, and geodesics all in a range of sizes that makes them appropriate for various age groups from toddler (very large and easy to grasp) to adult (miniature, precision) with all the pieces from all the sizes and types interconnecting.

## **BRIEF DESCRIPTION OF THE FIGURES**

For the purpose of illustrating the invention, there are shown in the accompanying drawings forms which are presently preferred; it being understood that the invention is not intended to be limited to the precise arrangements and instrumentalities shown.

FIG 1 shows in perspective view a rod and hub assembly that uses the female vertical connector.

FIG 2 shows in plan view a hub with two forms of the female vertical connector - type 2 and type 3 connectors - type 1 is the basic type genderless.

FIG 3 shows in perspective view a hub with another form of the female vertical connector - type 4.

FIG 4a shows a bottom perspective view of an elongated connector - type 6 - that is part of an adapter block.

FIG 4b shows a top perspective view of an elongated connector - type 6 - that is part of an adapter block.

FIG 5 shows in plan view a hub with another form of the vertical female connector - type 5.

## **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Disclosed are improvements to the inventions disclosed in the related application. The disclosures include chamfered or filleted entries on the basic type 1 genderless connectors to improve ease of assembly of the hubs and rods. Also disclosed are 'vertical' connectors that are female connectors that mate with genderless type 1

connectors and allow for connection of rods to hubs or of rods to blocks that would not otherwise be available. As in the basic type connector these other connectors - types 2 through 6 - rely on a slight interference fit to hold (as is disclosed in the related application). Also disclosed is an 'adapter block' that allows rods of genderless construction systems to mate with traditional block systems. These block systems rely on an interference fit between vertically extruded bosses. We adapt the 'down bosses' in our adapter block with a vertical female type 6 connector.

Said vertical connectors are the negative of type 1 genderless connectors. Which is to say that they can be modeled by Boolean operations on solids by subtracting a type 1 connector from a solid. If only the slot end of the type 1 connector is used for the subtraction then connectors of type 3 and type 4 are produced. If the web end is used for the subtraction then type 2, type 5 and type 6 connectors are produced.

In an optimally designed vertical female connector the surfaces of connection to a type 1 connector are the x-bearing surfaces. However, vertical female connectors type 4 and type 6 must also use the web-bearing surface of the finger not inserted as a surface of connection. These types are used when space is limited and there is not enough room for both halves of a vertical female connector.

The chamfer or filleted entries on the type 1 connectors ease the angle of entry from 90°.

## **DETAILED DESCRIPTION OF THE DRAWINGS**

We disclose inventions that aid in the construction of complex hub, rod, and block assemblies in which rods are inserted perpendicular to the major plane of said hubs and blocks. These inventions are improvements to hub, rod and block construction systems in which the major plane of connection is parallel to the major plane of the part. In FIG. 1 we show an assembly 11 of six rods, all effectively identical to rod 12, and three hubs, all effectively identical to hub 13. Connection is effected by means of type 1 connectors on rods, all effectively identical to connector 14a on rod 12, and by type 4 connectors on hubs, all effectively identical to connector 15a in FIG. 1 and 15b..c in FIG.

3. (Note that connector 14b on hub 13 is functionally identical to connector 14a.). FIG. 3 shows a hub 31 identical in function to hub 13 where it is shown in near plan view for clarity.

Connection is achieved when a rod's type 1 connector is inserted into a type 4 connector, such as 15b, in such a way that its x-bearing surfaces 16a and 16b on its finger 17a slide past x-bearing surfaces 32a and 32b and its web-bearing surface 18b on finger 17b slides past web-bearing surface 33. Note that it is neither necessary nor usually desirable for a rod finger back surface 19 to contact a vertical female back surface 34.

In FIG. 2 we show in plan view a hub 21 with vertical female connectors distributed in a polar array with their principal axis perpendicular to the hub's main axis. These vertical female connectors consist of type 2 connectors all identical to 22, and type 3 connectors all identical to 23. Said connector 23 is constructed of two identical halves 24a and 24b. The separation between the two halves effectively creates a web 25 which acts as a stop to the insertion of a type 1 connector which cannot be inserted past its own web 10. On the other hand, type 2 connector 22 lacks such an obstruction and a rod with the same profile 25 can pass all the way through with only the interference fit of the x-bearing surfaces 26 resisting its passage.

Also are shown eight type 1 connectors all identical to connector 27 with chamfered or filleted entries 28 and backfills 29. When inserting a rod, web faces 71 and 72 touch before the chamfer tip 28 touches the backfill 29.

In FIG. 5 a hub 51 is furnished with type 5 connectors all identical to 52. Said connectors lack web and web faces. Interference fit is achieved at x-bearing surfaces 53a and 53b and abbreviated x-bearing surfaces 54a and 54b.

In FIG. 4b we show an adapter block with vertically extruded hollow bosses 41 on the top. The block is a hollow rectangle open at the bottom.

In FIG. 4a we show a hollow rectangle adapter block 40 open at the bottom. When one block is placed on top of another, said top bosses 41 mate, by means

of an interference fit, with vertically extruded hollow down bosses 42 placed in block 40's hollow bottom 43. Vertical female connectors identical to 44 are placed within down bosses 42. Said connectors 44 consist of two hollow fingers 45a and 45b attached to the wall 46 of said connector. Said fingers 45a and 45b can optionally be filled at the top and furnished with chamfered tips 47a and 47b. Connection is achieved to a rod furnished with type 1 connectors by means of an interference fit at x-bearing connecting surfaces 48a..d when said rod is inserted and its x-bearing surfaces slide past 48a..d with an interference fit.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and accordingly, reference should be made to the appended claims rather than to the foregoing specification as indicating the scope of the invention.